

FERTILIZER MERCHANDISING

IN NORTH DAKOTA



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FOREWORD

The authors wish to acknowledge the contributions of the clerical and professional staff of the Department of Agricultural Economics who have participated in the preparation of this report. Dr. Delmer Helgeson, Mr. Timothy Petry, and Mr. Donald Thomson have been especially helpful with their comments and suggestions.

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Highlights

The utilization of commercial fertilizer in the U.S. has increased nearly fourfold in the past 25 years, when measured on the basis of primary nutrients. Most of the increase has been in the use of nitrogen. Important regional shifts in fertilizer utilization include a reduction in the eastern and southern regions and gains in the Corn Belt and Plains States.

Fertilizer utilization in North Dakota increased nearly sixfold during the 1957-77 period. Heavy applications per acre have been common in the Red River Valley, but there has been a gradual increase in the other areas of the state as well. In 1964, 52 percent of the wheat acres harvested were fertilized. About 65 percent of the wheat acres received some fertilizer in 1976.

There were 109 commercial wholesale fertilizer dealers in North Dakota in 1972. The largest four wholesale firms accounted for 58 percent of the fertilizer sold in the state during the four-year period, 1969-72. The top eight firms accounted for 77 percent of the market during this period.

There were 205 retail bulk fertilizer mixing firms in 1972. About 45 percent of these were located in the Red River Valley. Only 22 percent of the retail dealers were located in the western half of North Dakota.

The most common terms of trade that accompany fertilizer sales include custom blending, applicator rentals and service, soil testing, credit policies, and a variety of discounts. Dealers state that bulk spreading and credit terms are their most important services offered.

Provisions are made for the inspection of all commercial fertilizer sold in the state. Dealers are required to submit semiannual reports on tonnage shipped into North Dakota. Inspection, sampling, and analysis are conducted by the State Laboratories Department.

FERTILIZER MARKETING IN NORTH DAKOTA

by

Donald E. Anderson, Gordon W. Erlandson, and James M. Moench*

The volume of commercial fertilizer sold to North Dakota farmers has increased from 98 thousand tons in 1957 to 628 thousand tons in 1977. The consequences of this increase have had impacts on the entire agricultural sector. Fertilizer merchandising has developed into a substantial industry within the state. Changes in the product, method of application, as well as rapid increases in volume have required adjustments in the marketing channel.

This report presents a descriptive overview of the marketing channel for fertilizer sold in North Dakota. It highlights changes in fertilizer utilization and the adjustments made by wholesalers and retailers. Data on size and number of firms, types of operations, types of ownership, entry conditions, degree of specialization, and concentration measures are included in the analysis of the industry structure. Conduct dimensions include pricing differentials, competitive activities, services granted, and the effectiveness of brands and trade names to attract consumer loyalty.

Primary data for this study were gathered from a mail questionnaire sent to all bulk (commercial fertilizer distributed in a nonpackaged form) fertilizer dealers in North Dakota. Information was obtained on the general market structure of the North Dakota fertilizer industry and on specific market conduct elements. The period of study covered the marketing years of 1972 and 1973. Secondary data were obtained from numerous fertilizer bulletins and publications from state and federal agencies.

History of the Fertilizer Industry

Traditionally, the fertilizer producing industry has had a high degree of concentration. The period before World War I might be characterized as one of natural monopolies in the most important fertilizer branches. The natural nitrate of soda deposits in Chile controlled by a Chilean nitrate cartel was the fertilizer industry's principal source of nitrogen before World War I.

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At the outbreak of World War II, 90 percent of the fertilizer marketed in the U.S. still came from Chile plus two domestic producers (5:163).

Until World War II, potash prices and sales in the U.S. were generally controlled by European cartels. A German cartel supplied nearly all the potash used in the U.S. until World War I. Between World War I and World War II, a French-German importing agency and from one to three domestic potash mines were the only sources (6:363).

Phosphate rock was discovered in Florida in the 1880's. Initially, ownership of rock-bearing land was widely dispersed. The high-cost producers soon eliminated themselves, leaving seven or eight producers with control of most of the phosphate. When phosphate rock was discovered in North Africa in 1917, the U.S. phosphate firms formed a cartel to protect their export interests. Soon the same cartel was operating in the domestic markets. An international cartel arrangement proved to be mutually advantageous to both U.S. and North African producers in the early 1930's. After World War II, phosphate was discovered in the western states, including Montana and Idaho. Other countries have entered the mining of phosphate also. This brought an end to the domestic and international cartels (7:36).

Before 1903 most of the sulphur was imported from Italy. Between 1903 and 1952 domestic sulphur production increased from 35,098 long tons to 5.3 million long tons. This production was concentrated in the hands of four producers, with the largest two accounting for 90 percent of the total output (7:75).

Concentration of control has traditionally been high in the primary raw material markets and the sellers of these materials have been involved in numerous antitrust actions.

The Mixing and Distribution Market

The mixing and distribution aspect of the fertilizer industry is different than the raw product market structure. While sellers of mixed fertilizers buy in highly concentrated markets or are vertically integrated with them, they sell in a market structure which is quite competitive. A 1961 study of 73 Nebraska counties showed that each county had an average of 12 fertilizer dealers (17:18).

Fertilizers are not available to field crops in pure elemental form and are supplied in chemical combinations with one or more of the essential

elements. This involves manufacturing or processing complexes.. Thus, the fertilizer industry is a subindustry of the chemical industry which is characterized by a few firms controlling most of the market. The fertilizer industry is one of the largest chemical industries in the U.S.

The fertilizer industry may be defined as comprising all producers, processors, and mixers of fertilizer nitrogen, phosphate, and potash--the three principal plant nutrients. A fourth element, sulphur, sometimes is included. The most important phosphatic material, superphosphate, is produced from approximately equal quantities of sulphuric acid and phosphate rock. Thus, the farmer's supply of fertilizer depends upon several sources of raw materials.

Nitrogen stimulates the vegetative or leafy portion of the plant. Nitrogen fertilizers are derived from (1) natural products, such as petroleum or natural gas; (2) the by-product ammonia produced in the manufacture of coke; and (3) from the atmosphere by means of chemical processes known as nitrogen fixation (4:144).

Phosphorus, an essential part of protoplasm, greatly stimulates plant growth--especially the roots. Sources of phosphorus fertilizers are (1) mineral phosphates, generally designated as phosphate rock; (2) basic slag, a by-product of the steel industry; and (3) bones, a by-product of the meat packing industry. Mineral phosphates or phosphate rock are by far the most important source of phosphorus (4:147).

Potassium functions in plants with the synthesis of their foods. The principal potash fertilizers in the U.S. are potassium chloride and potassium sulfate. Nearly all the world's supply of fertilizer potassium is in the form of water-soluble salts derived from salt lakes and other brines and chiefly from deposits of water-soluble minerals. The potassium reserves of the world are very large and they are found in most parts of the world. The greatest reserve of potassium outside of soil itself is sea water, which contains about 2,000,000 tons of potash per cubic mile (4:149). Superphosphate is the principal phosphatic fertilizer used in the U.S. and most other countries. Untreated phosphate rock is low in available phosphorus for plants. Phosphate rock, plus sulfuric acid, produces ordinary superphosphate with 16 percent to 20 percent available phosphoric acid (P_2O_5). Triple superphosphate can be obtained by combining phosphate rock with

orthophosphoric acid to reach a higher analysis phosphate fertilizer with 44 percent to 48 percent available phosphoric acid (4:147).

Markham in his study of the fertilizer industry maintained that the producers of phosphatic fertilizers occupy a "pivotal position" in the flow of plant nutrients from the producer to the farmer. A large portion of the fertilizer mixing industry is vertically integrated with the production and processing of phosphate rock. Nitrogen and potash producers do not sell significant amounts direct to farmers; instead they sell to integrated phosphate producers and unintegrated fertilizer mixers who in turn sell to farmers (6:361).

The U.S. Department of Agriculture has compiled a flow diagram which defines the market channels through which fertilizer is moved from the initial producer to the final consumer (Figure 1).

Trends in Fertilizer Consumption in the U.S.

The total consumption of fertilizer increased from 18 million tons in 1950 to nearly 49 million tons in 1976 (Table 1). When measured on the basis of primary nutrients, the increase in consumption was more than four-fold. Most of the increase has been in the use of nitrogen, which increased from about one million tons to over ten million tons since 1950. Significant shifts in regional consumption of primary plant nutrients have occurred since 1950 (Table 2). Important reductions have taken place in the eastern and southern regions. Gains in the relative positions have taken place in the other regions, but most noticeably in the Corn Belt and the Plains States.

Trends in Fertilizer Utilization in North Dakota

The impact of fertilizer utilization is indicated by earlier North Dakota studies. In a five-year period (1957-61), records show that the use of fertilizer on 32,739 acres of small grains increased farm income by \$71,900 for an added return of \$2.20 per acre (8:8).

Figures 2 through 6 portray the trends in fertilizer utilization in North Dakota with respect to application rates throughout the state during the period 1954-74. A visual inspection of the contour maps reveals use of fertilizer was a well-accepted fact in the Red River Valley by 1954;

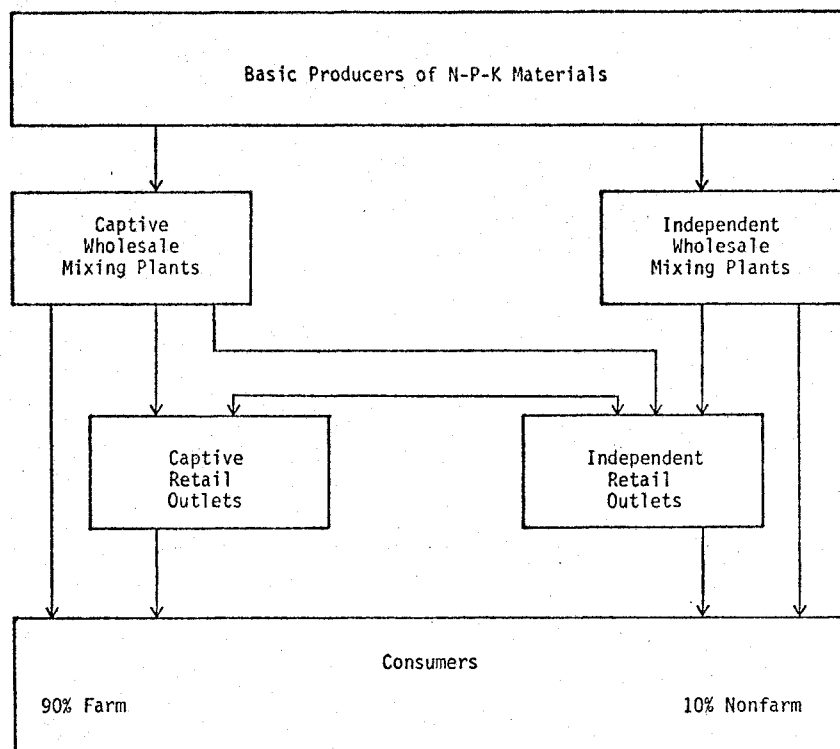


Figure 1. Domestic Fertilizer Distribution Channels in the U.S., 1967

SOURCE: U.S. Department of Agriculture, Economic Research Service, "Domestic Fertilizer Distribution Channels, Ndg. ERS 5357-67(9)."

whereas, it was a relatively new and untried practice in the rest of North Dakota. One notable exception to this in 1954, however, is McKenzie County where there was considerable irrigation being used. This encouraged early experimentation with fertilizer. (See Appendix for actual data.)

The total quantity of fertilizer used in North Dakota increased from about 54,000 tons in 1954 to nearly 157,000 tons in 1959, an increase of 191 percent (16:12). Every county increased consumption of fertilizer from 1954 to 1959. One county (Emmons) increased its utilization 59 times.

The total quantity of fertilizer used on farms in North Dakota increased from 157,000 tons in 1959 to over 179,000 tons in 1964, an increase of 14 percent (12:6). Average amounts of fertilizer applied per acre tended to be highest in the eastern, more humid areas of the state and lowest in the western, drier areas. This east-west variation is roughly in accordance with average annual precipitation, with the notable exception of some irrigation areas in the western part of the state.

TABLE 1. TOTAL AND PRIMARY NUTRIENT CONSUMPTION OF ALL FERTILIZERS IN THE U.S.^a

Year Ending on June 30	Total Consumption (Product)	Consumption of Primary Nutrients			
		Nitrogen (N)	Phosphates (P ₂ O ₅)	Potash (K ₂ O)	Total
----- 1,000 tons -----					
1950	18,343	1,005.4	1,949.8	1,103.1	4,058.3
1955	22,726	1,960.5	2,283.7	1,874.9	6,119.1
1960	24,877	2,738.0	2,572.4	2,153.3	7,463.7
1961	25,567	3,030.8	2,645.1	2,168.5	7,844.4
1962	26,615	3,370.0	2,807.0	2,270.5	8,447.5
1963	28,844	3,929.1	3,072.9	2,503.4	9,505.4
1964	30,681	4,352.8	3,377.8	2,729.7	10,460.3
1965	31,836	4,638.5	3,512.2	2,834.5	10,985.2
1966	34,532	5,326.3	3,897.1	3,221.2	12,444.6
1967	37,081	6,027.1	4,304.7	3,641.8	13,973.6
1968	38,743	6,787.6	4,453.3	3,792.6	15,033.5
1969	38,949	6,957.6	4,665.6	3,891.6	15,514.8
1970	39,589	7,459.0	4,573.8	4,035.5	16,068.3
1971	41,118	8,133.6	4,803.4	4,231.4	17,168.4
1972	41,206	8,022.3	4,873.7	4,326.8	17,212.8
1973	43,288	8,295.1	5,085.2	4,648.7	18,029.0
1974	47,094	9,157.2	5,098.6	5,028.6	19,338.4
1975	42,508	8,607.7	4,511.0	4,452.6	17,571.4
1976 ^b	48,864	10,344.9	5,215.2	5,207.6	20,767.7

^aIncludes Puerto Rico.

^bPreliminary.

SOURCE: Paul, Duane A., et al., "The Changing U.S. Fertilizer Industry," U.S. Department of Agriculture, Economic Research Service, Agricultural Economic Report No. 378, Washington, D.C., August, 1977, p. 48.

The total fertilized acreage in North Dakota increased from 1,682,000 acres in 1954 to about 5,232,000 acres in 1959. Wheat and barley together accounted for 88 percent of this increase in fertilized acreage (16:11). Total fertilized acreage in North Dakota increased to 5,539,000 acres in 1964. Most of this increase resulted from increased fertilization of wheat. Fertilized acreage of barley decreased by 467,000 acres, due largely to reductions in barley acreage as a result of the feed-grain program (12:6).

Fertilizer was used on 48 percent of North Dakota farms in 1964. Despite the tremendous increase in use of fertilizer, North Dakota farmers had not yet reached the point of optimum fertilizer usage. Studies show only 52 percent of the wheat acres harvested in 1964 were fertilized. If

TABLE 2. CONSUMPTION OF PRIMARY PLANT NUTRIENTS BY CROP PRODUCTION REGION AS A PERCENTAGE OF TOTAL U.S. CONSUMPTION^a

Region	Nitrogen (N)		Phosphate (P ₂ O ₅)		Potash (K ₂ O)		Total	
	1950	1975	1950	1975	1950	1975	1950	1975
	<i>percent</i>							
Northeast	9	4	15	6	15	6	13	5
Lake States	3	8	8	11	10	16	7	11
Corn Belt	10	28	19	33	20	40	18	32
Northern Plains	2	15	2	10	2	3	2	11
Appalachian	17	6	20	9	20	11	19	8
Southeast	21	8	18	8	21	13	19	9
Delta States	15	5	5	4	5	4	8	5
Southern Plains	3	9	5	7	2	3	4	7
Mountain	2	5	2	5	2	1	2	4
Pacific	12	10	4	6	2	2	5	7
Other	6	2	2	1	1	1	3	1

^aIncludes Alaska, Hawaii, and Puerto Rico.

SOURCE: Paul, Duane A., et al., "The Changing U.S. Fertilizer Industry," U.S. Department of Agriculture, Economic Research Service, Agricultural Economic Report No. 378, Washington, D.C., August, 1977, p. 49.

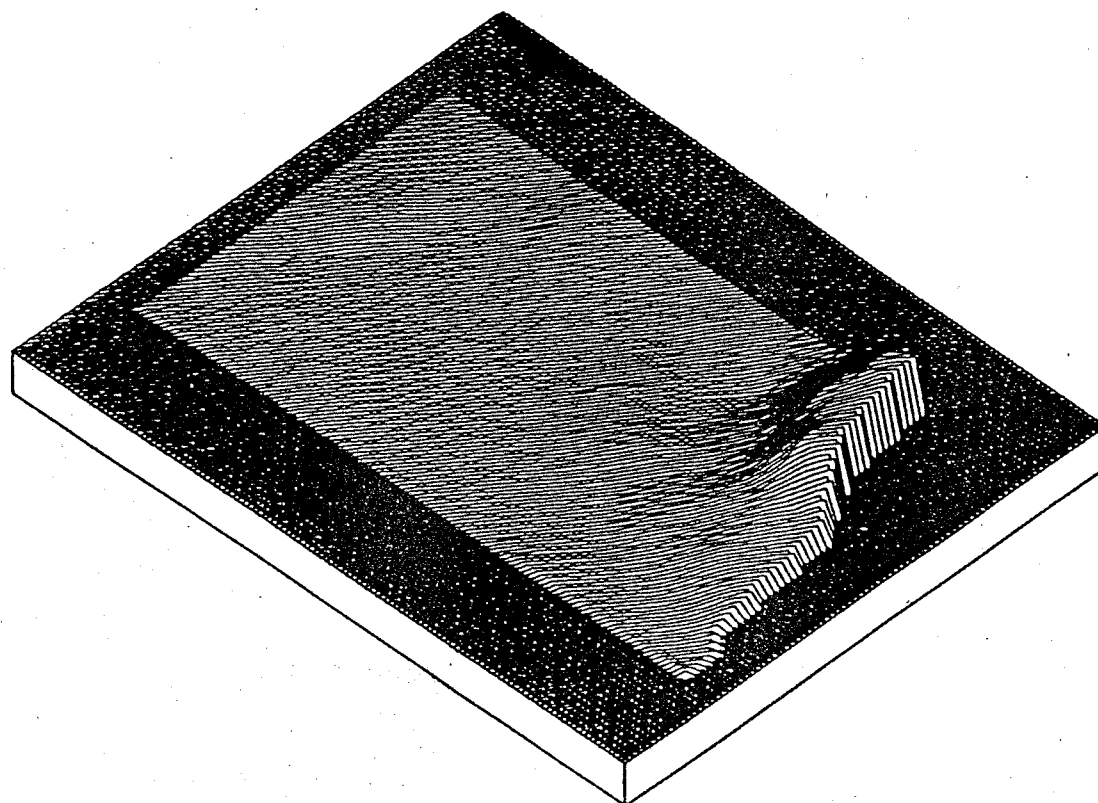


Figure 2. Average Pounds of Fertilizer Applied to Cropland Acres by County in North Dakota, 1954

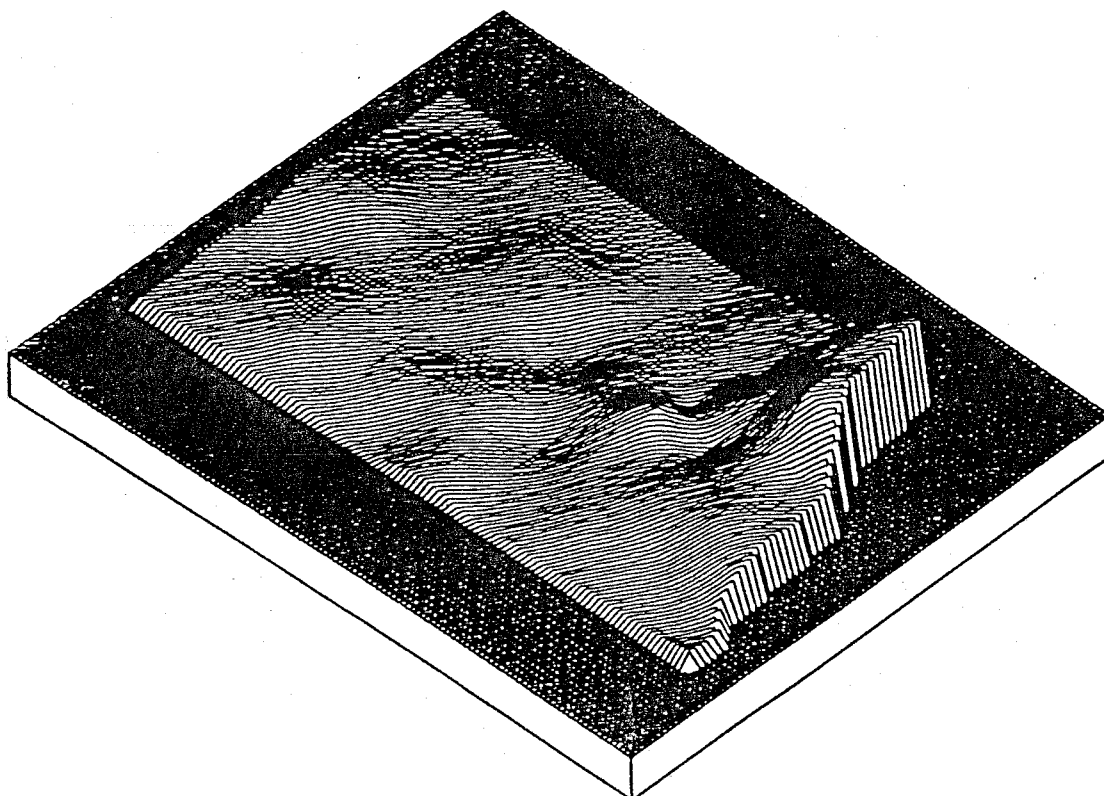


Figure 3. Average Pounds of Fertilizer Applied to Cropland Acres by County in North Dakota, 1959

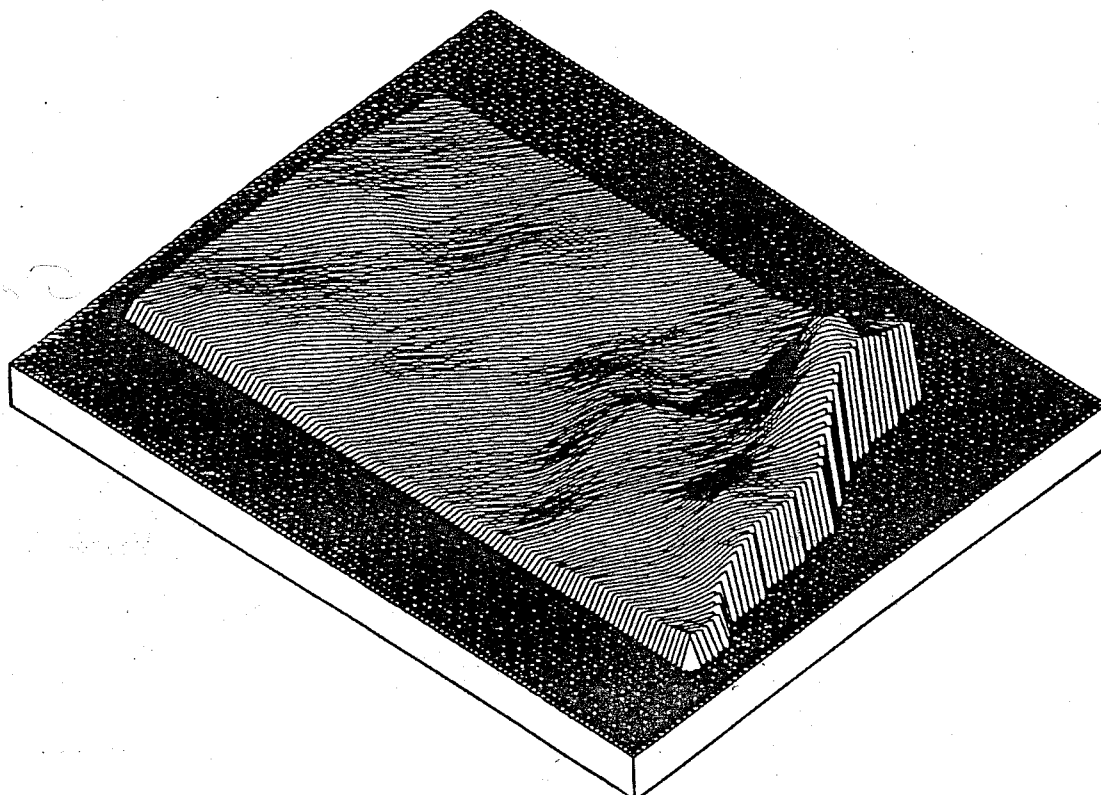


Figure 4. Average Pounds of Fertilizer Applied to Cropland Acres by County in North Dakota, 1964

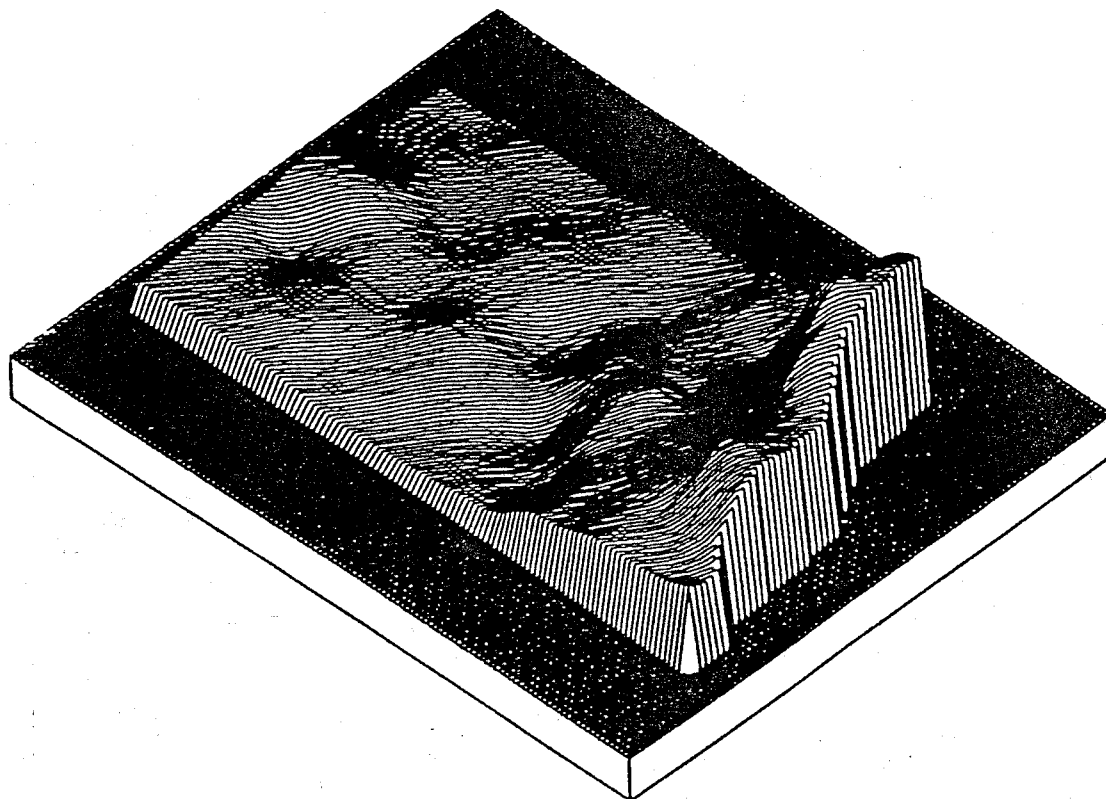


Figure 5. Average Pounds of Fertilizer Applied to Cropland Acres by County in North Dakota, 1969

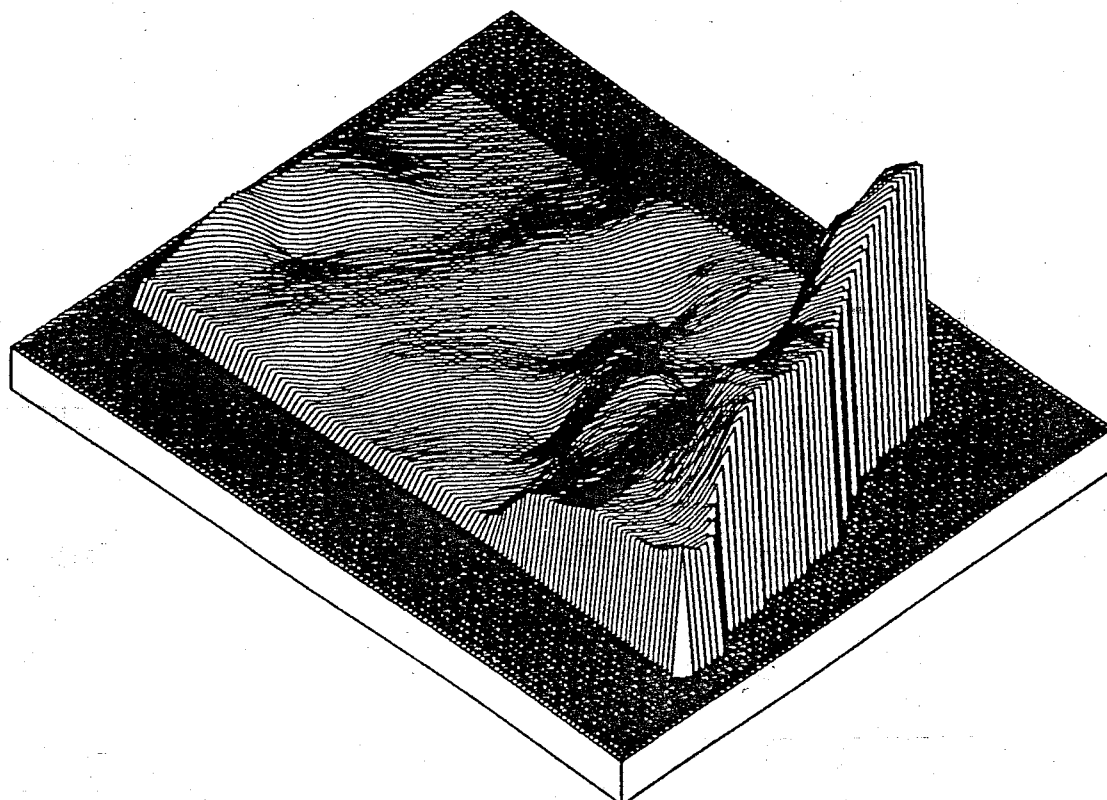


Figure 6. Average Pounds of Fertilizer Applied to Cropland Acres by County in North Dakota, 1974

the other 48 percent of wheat acreage had been fertilized, farmers in North Dakota could have added another \$3,950,000 to their net wheat income (12:8).

Fertilizer utilization has increased steadily, following the same east-west pattern already established. The proportion of wheat acres receiving any fertilizer in 1976 was about 65 percent, which compares with the national average of 71 percent for all wheat (14:67).

The North Dakota Mixing and Distribution Market

Size and Number of Firms

The wholesale firms that merchandise fertilizer products in North Dakota were investigated to develop an overview of the industry. There were 109 commercial wholesale fertilizer registrants on record with the North Dakota State Laboratories Department in 1972. There were 340,635 tons of fertilizer sold in North Dakota during the two reporting periods in 1971 when these 109 companies were on record (Table 3). From January to June of 1972 there were 233,938 tons sold. The top four wholesale firms reported total sales of 178,035 tons imported into and distributed to the North Dakota retail fertilizer market during the first six months of 1971. The January to June tonnage figure appears high when compared with the total year's figure of 368,897 tons. However, according to Koehler, most of the fertilizer sold in the state during any given year is shipped during the reporting period January to June (11). Retail dealers are then assured of their supply before the planting season, provided they have adequate storage facilities.

There were 1,370,112 tons of fertilizer sold in North Dakota during the four years from 1969 to 1972. The Top four wholesale firms sold a total of 798,104 tons during this four-year period. These figures show that the top four wholesalers accounted for 58 percent of the fertilizer sold in the state during the four-year period from 1969 to 1972. This percentage figure indicates that the concentration ratio of the top four wholesale dealers was relatively high during this period (Table 4\$. The concentration ratio* of

*Concentration ratio--A measurement tool which takes into account both the number and size distribution of firms in a market, yet presents the results in a form simple enough that is is easy to interpret. To compute, rank the firms in order of size starting with the largest. (Usually measured in sales or number of employees.) Then starting from the top of the list, add up the percentages for the top X firms. Published statistics usually give concentration ratio for the largest 4, largest 8, and sometimes the largest 20 firms in the industry.

TABLE 3. TOTAL TONS OF FERTILIZER SOLD IN NORTH DAKOTA AS REPORTED TO NORTH DAKOTA STATE LABORATORIES DEPARTMENT, 1957-76

Year	Tons Sold	Year	Tons Sold
1957	98,935	1968	312,468
1958	112,473	1969	327,712
1959	141,863	1970	332,868
1960	145,103	1971	340,635
1961	160,049	1972	368,897
1962	138,423	1973	547,046
1963	165,875	1974	486,159
1964	193,140	1975	544,275
1965	233,726	1976	636,027
1966	288,715	1977	628,190
1967	362,209		

SOURCE: North Dakota State Laboratories Department, "Feeds, Fertilizer, Pesticides Report," Annual Bulletins, 1957-76, Bismarck, North Dakota.

TABLE 4. PERCENTAGE OF TOTAL REPORTED SALES ACCOUNTED FOR BY THE TOP EIGHT FERTILIZER WHOLESALE REPORTING FIRMS DURING THE PERIOD 1969-72, NORTH DAKOTA

Firm	Jan-Jun Sales 1972	Jul-Dec Sales 1972	Jan-Jun Sales 1971	Jul-Dec Sales 1971	Jan-Jun Sales 1970	Jul-Dec Sales 1970	Jan-Jun Sales 1969	Jul-Dec Sales 1969	Four-Year Total Sales
Top Four Firms	.61	.70	.57	.73	.59	.76	.43	.75	.58
Top Eight Firms	.78	.74	.74	.78	.74	.82	.64	.79	.74

SOURCE: Fertilizer tonnage report submitted semiannually to the North Dakota State Laboratories Department.

58 percent, although high, does not approach the 100 percent concentration ratio of a monopoly (one firm) industry; therefore, the North Dakota wholesale fertilizer may be classed as an "oligopoly" (an industry with "few" firms).

The top eight firms accounted for 77 percent of the market during the 1969-72 period. Because of the relative importance of these large firms, it is desirable to examine the type of ownership, type of business organization, and their business policies.

Two of the top eight wholesale firms are cooperative organizations. The firms wholesale to a variety of businesses (gas stations, grain elevators,

etc., as well as retail bulk blending plants) which are members of the cooperative chain, as well as to private fertilizer retail enterprises. The cooperatives sell dry bulk, bagged, and liquid fertilizer as demanded by the area served. Fertilizer was sold under their own brand names, with major dependence on brand-name advertising to inspire patron loyalty.

Of particular interest is the one firm in the top eight which at the time of the study handled liquid fertilizer exclusively. This firm is unique due to its rapid growth in the last decade. Liquid fertilizer has enjoyed increased popularity in North Dakota during recent years, especially in the Red River Valley farming area. Liquid fertilizer has the advantages of ease of handling and storage, versatility, and lower cost of application per acre (although the initial customer investment for a liquid applicator is higher than for comparable bulk dry fertilizer applicator equipment). The liquid fertilizer firm has grown from fifth position in 1969 to third place in 1972. This fact attests to the growth in popularity of liquid fertilizer in North Dakota.

Three of the top eight wholesale firms sell fertilizer as their dominant product. Fertilizer sales account for 90 to 100 percent of their total earnings.

Retail Sellers

There were 205 retail bulk mixing firms registered with the North Dakota State Laboratories Department and in the 1972-1973 Directory of North Dakota Manufacturers. The percentage of these firms located in the four farming areas were: Red River Valley, 45 percent; East Central, 33 percent; West Central, 13 percent; and Western, 9 percent. The major portion (78 percent) of the bulk retail fertilizer firms are located in the agriculturally intensive eastern half of the state, which includes the Red River Valley and the East Central farming areas according to these figures. The average retail fertilizer dealer employed less than 10 workers. Only 22 percent of the retail dealers were located in the western half of North Dakota. The western half has traditionally been considered the ranching and cattle raising section of the state, although small grain farms are found throughout the area.

Bulk fertilizer plants were classified as either cooperatively or privately owned (Table 5). Cooperative type ownership accounted for 58 of the 101 firms surveyed. Forty-three of the firms surveyed were privately owned companies.

TABLE 5. TYPE OF OWNERSHIP OF FERTILIZER RETAIL DEALERSHIPS LOCATED IN THE FOUR MAJOR FARMING AREAS IN NORTH DAKOTA, 1973

Type of Firm	Red River Valley	East Central	West Central	Western	Total Number of Firms
Cooperative	19	23	8	8	58
Privately Owned	18	17	5	3	43
Total	37	40	13	11	101

SOURCE: North Dakota Fertilizer Questionnaire, 1973.

Dry Versus Liquid Fertilizer

The data on fertilizer installations obtained from the North Dakota State Laboratories Department indicated that bulk blenders were divided into two groups, with 64 percent handling dry mix and 36 percent handling liquid. These figures contain some inaccuracies because the North Dakota State Laboratories Department does not classify the firm which handles both liquid and dry.

Data from the mail questionnaire were summarized in Table 6 to gain further insight into spatial dispersion of the bulk fertilizer plants and the type of fertilizer they sell. Dry fertilizers were sold in all areas of the state and by the largest number of dealers in all areas. Dry fertilizer was popular throughout the state due to the ease with which it can be moved over great distances and stored. Liquid fertilizer requires specialized, high-cost tanks and equipment for its storage and transportation. Liquid fertilizer plants were found in the largest concentration in the Red River Valley (near the large wholesaler outlets). Firms which sell both liquid and dry were found only in the Red River Valley due to the larger amounts of fertilizer used on the various specialty crops grown in the Red River Valley. Liquid fertilizer requires appreciably less labor to apply than dry bulk fertilizer. The labor-saving characteristics of liquid offset the initial high cost of the applicator system in areas where the application rate of fertilizer per acre is high.

Type of Retail Firm and Location

The products and the services which a firm offers other than fertilizer were used to segregate the firms with bulk fertilizer mixing

TABLE 6. BULK RETAIL FIRMS IN THE FOUR FARMING AREAS BY TYPE OF FERTILIZER SOLD, NORTH DAKOTA, 1973

Area	Liquid	Dry	Liquid and Dry	Total Number
Red River Valley	5	12	20	37
East Central	4	21	15	40
West Central	3	9	1	13
Western	0	10	1	11
Total	12	52	37	101

SOURCE: North Dakota Fertilizer Questionnaire, 1973.

facilities into the eight separate categories (Figure 7). The eight categories and the percentages of firms in each were:

1. Fertilizer mixing only--2.5 percent.
2. Grain elevators with fertilizer mixing--30 percent.
3. Retail gasoline stations with fertilizer mixing--24 percent.
4. Wholesale fertilizer sales with mixing facilities--1.5 percent.
5. Retail farm equipment dealers with mixing facilities--.5 percent.
6. Feed stores with fertilizer mixing--2 percent.
7. Farm supply stores with fertilizer mixing--40 percent.
8. Retail stores with fertilizer mixing--.5 percent.

The number of firms corresponding to each category is shown in Figure 7 to illustrate the location of each of the 205 bulk blending firms included in this analysis. Certain wholesale fertilizer firms supply other retail firms with products in addition to maintaining their own retail sales facility.

The data in Table 7 indicate that the largest number of retail firms were located in the Red River Valley area. The number of bulk mixing firms in each area of the state decreased from east to west. Farm supply stores and grain elevators with fertilizer mixing ranked first and second in total numbers of bulk fertilizer plants in the Red River Valley and East Central farming areas. Retail gasoline stations and farm supply stores with fertilizer mixing ranked first and second in the western half of the state. Statewide, farm supply stores, grain elevators, and retail gasoline stations ranked one, two, and three, respectively, in terms of total number of firms that retail bulk fertilizer.

Market Characteristics

Product Differentiation

If one producer's output can be distinguished from another's, the products are said to be differentiated. Dry and liquid fertilizer in the

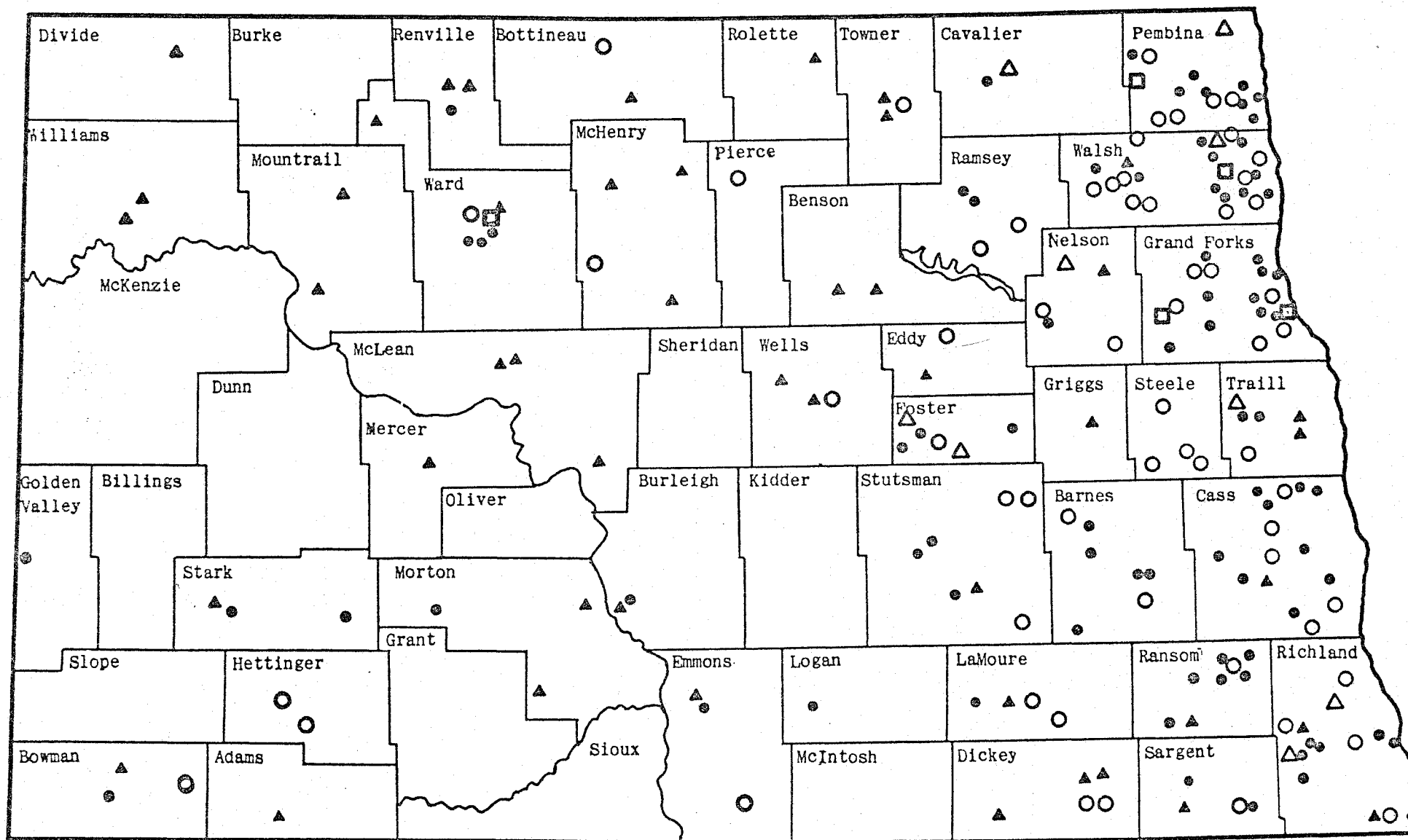


TABLE 7. NUMBER OF FERTILIZER MIXING FACILITIES IN NORTH DAKOTA BY TYPE OF BUSINESS AND LOCATION, 1973

Farming Area	Red River Valley	East Central	West Central	Western	State Total
Fertilizer Mixing Only	4	0	1	0	5
Grain Elevator With Fertilizer Mixing	32	23	5	3	63
Retail Gas Stations With Fertilizer Mixing	6	16	14	11	47
Wholesale Fertilizer Sales With Fertilizer Mixing	2	1	0	0	3
Retail Farm Equipment Dealers With Fertilizer Mixing	2	1	0	0	3
Feed Store With Fertilizer Mixing	0	2	0	0	2
Farm Supply Store With Fertilizer Mixing	45	24	7	5	81
Retail Store With Fertilizer Mixing	1	0	0	0	1
Total	92	67	27	19	205

SOURCE: North Dakota Fertilizer Questionnaire, 1973.

bulk industry are two physically different products which require totally different equipment to transport, measure, and apply. If physical appearance is used as a measurement of product differentiation, it is soon apparent that one brand of fertilizer looks remarkably like another. The only apparent features distinguishing one from another is the brand name on the label. To determine if the word "brand" was a form of product differentiation, firms responding to the mail survey were questioned to reveal any strong brand identification. The retail dealers were asked how many brands they sold. The average number of brands sold was 1.7, which would indicate that about half the firms responding to the survey sold only one brand and the other half sold more than one. The reason that many of the firms sold only one brand was due to an affiliation with a cooperative wholesaler. Brand was

not considered to be of major importance in the selling of fertilizer by dealers. The dealers when asked what factors influenced retail sales stated that soil testing services were the most important and custom blending and bulk spreading were tied for second in producing sales. Price per ton was considered the most important factor by farmers when purchasing fertilizer.

Fertilizer brands can also be differentiated in ways not found in the physical product itself. Brand name did not play a major role in producing consumer preference in fertilizer retailing. The "conditions of sale" can differ in many ways, particularly if the manufacturer sells to retail dealers through his own wholesale outlets. Two questions were asked to identify the "conditions of sale" the retail firm faced:

1. Who sets your retail price? Your suppliers at the time of delivery or you, to meet your competition?
2. Do you receive the following discounts from your supplier?
 - a. Bulk purchase discount.
 - b. Cash purchase discount.
 - c. Off-season discount.
 - d. Transportation discount.

Nine percent said that their price was set by the supplier at delivery time, while the majority (88 percent) indicated that their price was set to meet competition. Only 1 percent claimed to be influenced by both.

Type of Discounts

Data in Table 8 show that retail firms most frequently received cash purchase and off-season purchase discounts. The table also identifies the percent of retail dealers who passed these types of discounts to their customers in some form.

These discounts may play an important role in product differentiation since 50 percent of the retail dealers surveyed felt their customers shop first for price per ton and other dealer services are a secondary consideration.

Barriers to Entry

The conditions of entry--measuring the advantage of established firms compared to potential entrants or, more precisely, the ability of established sellers to elevate prices without attracting new competitors--were difficult to measure precisely from data available. However, the barriers to entry can be estimated in some areas.

TABLE 8. TYPE OF DISCOUNTS RECEIVED BY BULK RETAIL FIRM AND PERCENT WHICH OFFERS DISCOUNT TO CUSTOMER, NORTH DAKOTA, 1973

Type of Discount	Discounts Received by Retail Firm		Percent Which Offers Discount to Customer
	<u>Yes</u>	<u>No</u>	
Bulk Purchase	45%	55%	20
Cash Purchase	65%	35%	24*
Off-Season	75%	25%	55
Transportation	20%	80%	20

*This figure also includes delayed interest payments until fall.

SOURCE: North Dakota Fertilizer Questionnaire, 1973.

There are four major barriers to entry (2:24):

1. Control of patent rights.
2. Scale economy barriers.
3. Absolute cost barriers.
4. Product differentiations.

There were no patent rights being controlled by any one firm; therefore, this does not pose a barrier to entry in the retail fertilizer market. Also, the costs faced by retail dealers for material, equipment, and labor were basically similar. There appeared to be no absolute cost barriers unless one differentiated between liquid and dry bulk fertilizers. It was common for the wholesaler in liquid retail outlets to own the bulk tanks and the stored fertilizer. The tanks may be leased to the retailer and the retailer must purchase the equipment necessary to transport and apply the liquid to the field. Dry bulk retailers generally owned the blending facility and all the necessary field equipment. There was a basic difference in the cost of the liquid versus the bulk plant at the time of this study. Sales representatives estimate that a 600-ton dry bulk plant with all the necessary equipment would cost 50 to 60 thousand dollars compared to 20 to 25 thousand dollars for a 600-ton liquid facility. While a 600-ton liquid plant was of adequate size, 1,000 tons or larger was considered necessary for a bulk dry plant. The reason for the difference in size was cited as distance from source of supply, which was usually closer for liquid. Most of the liquid plants in North Dakota were located in the Red River Valley (Table 6).

Size barriers to entry seemed to exist at the wholesale level. The top eight firms consistently sold 70 to 80 percent of the fertilizer sold in North Dakota (Table 4). These figures would indicate wholesale firms with a large organization, and market control enjoyed some degree of size barriers to entry. This was not true at the retail level where no evidence was found to show that retail firms were secure in their market simply due to their size or scale. The average size retail firm in North Dakota only sold between 3,000 and 5,000 tons of fertilizer a year. Any firm with the necessary capital can enter the retail market at any time.

The number of brands sold by each firm was analyzed as a measurement of product differentiation (Table 9). Fifty-six firms stated they sold only one brand, while 20 firms sold two brands, 21 firms sold three, and 3 firms sold four brands at retail. The average number of brands sold was 1.7 per firm. This would indicate that a little more than half the firms responding to the survey sold one brand exclusively, while a little less than half sold two or more. It appears that brand names alone do not present a product differentiation barrier to entry since it is possible for nearly half the reporting firms to retail two or more brands from the same facility.

TABLE 9. NUMBER OF DIFFERENT BRANDS OF FERTILIZER SOLD PER FIRM IN THE FOUR NORTH DAKOTA FARMING AREAS, 1973

Number of Different Named Brands Sold	Red River Valley	East Central	West Central	Western	Total Number of Firms
1	20	22	8	7	57
2	8	7	3	2	20
3	8	9	2	2	21
4	1	2	0	0	3
Total Reporting	37	40	13	11	101

SOURCE: North Dakota Fertilizer Questionnaire, 1973.

Terms of Trade

There are five basic terms of trade that generally accompany fertilizer purchase. These terms of trade include custom blending, applicator rentals,

soil testing, credit policies, and various forms of discounts. Other concessions may be considered terms of trade with particular purchases, but the five mentioned are the most common.

Of the five services, bulk spreading and credit terms were offered by equal percentages of dealers as their most important service (Table 10). Seventy-seven percent of the respondents stated they offered these services. A very close second (76 percent) in the order of service offered by the most dealers was applicator equipment rental. The third most frequently offered service was custom blending (73 percent) and the fourth was soil testing (68 percent).

TABLE 10. SERVICES AND DISCOUNTS OFFERED BY FERTILIZER RETAILERS BY FARMING AREA, NORTH DAKOTA, 1973

Area	Custom Blending	Soil Testing	Bulk Spreading	Applicator Equipment Rental	Credit	Transportation Discount	Seasonal Discounts	Quantity Discounts	Delayed Payments Until Fall
	percent								
Red River Valley	81	67	73	75	75	19	54	21	19
East Central	75	67	77	80	80	10	62	25	27
West Central	61	77	77	61	76	0	46	7	30
Western	54	63	91	81	72	0	45	18	27

SOURCE: North Dakota Fertilizer Questionnaire, 1973.

Bulk spreading and applicator equipment rental have long been important terms of trade in North Dakota, especially in the western portion of the state. This is due to the larger acreages found in the Western farming area. The average size farm in the western portion of the state in 1974 was approximately 1,270 acres compared to approximately 700 acres in the Red River Valley (15). The availability, speed of application, and ease of handling of bulk fertilizer material especially appeal to farmers with larger acreage in the western half of North Dakota.

Ninety-one percent of the reporting dealers offered bulk spreading in the Western farming area. This was the largest percentage of dealers in any one area to offer any specific service (Table 10). The two services which enjoyed the next strongest acceptance by dealers were custom blending in the Red River Valley and applicator equipment rental in the Western farming area. Eighty-one percent of the dealers offer both the services.

A transportation discount was included in the terms of trade least frequently offered by dealers. A transportation discount is given when the buyer supplies the means to move the fertilizer from its storage facility to the farm. Only 19 percent of the dealers in the Red River Valley and 10 percent in the East Central farming area offered a transportation discount in their terms of trade. No dealers in the West Central or Western area even offered this discount. This is not difficult to understand when a comparison is made between the size of area served by the firms in various parts of the state (Table 11). Over 50 percent of the firms serve an area 20 miles in diameter or smaller in the Red River Valley where the discount was offered. Over 50 percent of the firms in the Western area, where the discount was not offered, serve an area of 30 miles in diameter or larger.

TABLE 11. DIAMETER OF AREAS SERVED BY RETAIL FERTILIZER DEALERS IN THE FOUR FARMING AREAS, 1973

Diameter in Miles	Red River Valley	East Central	West Central	Western	Entire State
	- - - - - percent - - - - -				
10	18.9	7.5	0.0	0.0	9.9
20	40.5	45.0	23.1	18.2	37.6
30	16.2	32.5	23.1	36.4	25.7
50	10.8	10.0	23.1	27.3	13.9
75	0.0	0.0	7.7	9.1	2.0
100	13.5	5.0	23.1	9.1	10.9

SOURCE: North Dakota Fertilizer Questionnaire, 1973.

The service which dealers ranked as the most important in "producing" retail sales in North Dakota was soil testing (Table 12). Eighteen percent of all dealers indicated soil testing as most important. Thirty-six percent of the dealers in the Western area found soil testing most helpful in producing retail sales.

The two services which were ranked second most important to purchasers were custom blending and bulk spreading. Thirteen percent of the dealers ranked these two as the most important. The Red River Valley dealers felt custom blending was the most important in gaining customers.

TABLE 12. RELATIVE IMPORTANCE OF SPECIFIC SERVICES TO PRODUCING RETAIL SALES AS RANKED BY RETAIL DEALERS, 1973

Service	Red River Valley	East Central	West Central	Western	State Total
	- - - - - percent - - - - -				
Custom Blending	16	12	8	9	13
Soil Testing	13	16	15	36	18
Bulk Spreading	13	5	23	28	13
Applicator Equipment Rental	8	10	15	9	8
Credit	13	7	7	0	8
Transportation Discount	0	2	0	0	1
Seasonal Discount	0	2	0	0	1
Quantity Discount	0	0	0	9	1
Delayed Payment Until Fall	0	0	0	0	0
No Opinion	37	46	31	9	37

SOURCE: North Dakota Fertilizer Questionnaire, 1973.

Tied for third place were applicator equipment rental and credit. Of these two, credit was ranked highest by the Red River Valley dealers (13 percent).

Fertilizer and Soil Conditioner Law

The North Dakota State Laboratories Department is charged with the inspection and regulation of any person involved in the distribution of commercial fertilizer.* The duties which are to be administered by the State Laboratory are contained in Chapter 19-20.1 of the Fertilizer and Soil Conditioner Law. The law, in summary, begins by naming the enforcing official and defining the terms with which the official will be working.

*As defined by Chapter 19-20.1, Fertilizer and Soil Conditioner Law. Paragraph 19-20.1-02 (definition of words and terms), person included individual, partnership association, firm, and corporation.

Commercial fertilizer means any substance containing one or more recognized plant nutrient(s) which is used for its plant nutrient content and which is defined for use or claimed to have value in promoting plant growth (except unmanipulated animal and vegetable manure, meal lime, limestone, wood ashes, and gypsum).

The regulation which deals with registration states that each brand and grade of commercial fertilizer must be registered before being distributed in North Dakota. A fee of \$5.00 and the following information was required for registration:

1. The net weight of contents.
2. The brand and grade.
3. The guaranteed analysis.
4. The name and address of the registrant.
5. The source from which the nitrogen, phosphorus, and potassium are derived.

Provisions are made for the inspection of the commercial fertilizer sold in North Dakota. An inspection fee of \$.10 per ton of fertilizer distributed within the state was collected and used to defray the cost of the inspection visits, sampling, and analysis. The registrants were required to submit semiannual reports on tonnage shipped into North Dakota. The State Laboratories Department compiled and published its own reports in bulletin form from these reports.

Inspection

The State Laboratory had two permanent agents whose major function was to conduct the sampling and inspections that the director finds necessary in order to comply with this section of the Fertilizer and Soil Conditioner Law. Each agent had about one-half the state to sample and inspect. The agents divided the state in half along a line approximately the same as existed between the East Central and West Central farming areas. The two agents were also involved in the State Laboratories regulatory activities concerning the commercial feeds and pesticides industry. They divided their activities according to such criteria as time of year, progress of growing season, type of farming practiced in the area, and weather. Most of the fertilizer was sold between March 1 and June 1. Therefore, this was the period when the agents concentrate on fertilizer, although bagged fertilizer is sampled in the winter. The agents did the sampling and inspection; however, the actual analysis of the fertilizer samples was performed in the State Laboratories facility in Bismarck.

Regulation

The Fertilizer and Soil Conditioner Law defines the minimum plant food content required by law for a fertilizer grade to remain registered.

A fertilizer found to be mislabeled or misbranded cannot be distributed in North Dakota unless steps are taken to relabel or to remix it to the prescribed standards.

To enforce the act, the State Laboratory Department is empowered to cancel the registration of any brand of commercial fertilizer found to be using fraudulent or deceptive practices. The Department is also given power to issue "stop sale" orders, seize and/or condemn a fertilizer found not in compliance with the provisions of the law. However, all these actions must be followed by a hearing and the offender is given the opportunity to prove compliance with the law. Once the offender has reprocessed or relabeled his product to comply with the law, any penalty that has been imposed is usually lifted by the State Laboratory Department.

Fertilizer Price Analysis

Six variables were analyzed to determine if they influenced the retail price charged for fertilizer. The variables analyzed were transportation costs, location of the firm, complementary business activities, total tons of fertilizer sold, percent of total firm income obtained from retail fertilizer sales, and type of ownership.

The analysis of pricing variables was made using the Analysis of Variance statistical technique. This procedure identifies the variables which influence the price structure. Of the 101 questionnaires returned, 91 were found to contain sufficient price data to be analyzed in the Analysis of Variance procedure.

Fertilizer Price Adjustments

The fertilizer prices charged by the dealers were adjusted to a common base because of the wide variety of nutritive analyses and types of fertilizer used in North Dakota. The most popular fertilizer analysis sold in the state was 18-46-0, accounting for more than 50 percent of the observations in the sample. The price of the other fertilizer analysis was adjusted to the price of the base fertilizer--18-46-0.

The prices paid for the various analyses were adjusted based on plant nutrient content. The average price paid for 18-46-0 in North Dakota in 1973 was \$102.40 per ton. Based on methods found in Dalsted's

(3:44) study in 1970 and Bedker's (1:80) in 1973, the price of nitrogen, phosphate, and potash were found to be in a ratio of 2:2:1. By the use of the 2:2:1 ratio and a base price for the analysis 18-46-0 of \$102.40 per ton, the average cost of nitrogen and phosphate per pound is \$.08 and potash is \$.04. By using these figures on a cost per pound of nutrient, a standard price for any analysis can be calculated by using this formula:

$$\text{Cost Per Ton} = (\%N \times \text{lbs./Ton} \times \text{Price/lb. N}) + (\%P_{20_5} \times \text{lbs./Ton} \times \text{Price/lb. } P_{20_5}) + (\%K_{20} \times \text{lbs./Ton} \times \text{Price/lb. } K_{20})$$

where N = Nitrogen

P_{20_5} = Phosphate Price/lb. N = .08

K_{20} = Potash Price/lb. P_{20_5} = .08

lbs./ton = 2,000 Price/lb. K_{20} = .04

For example:

$$\begin{array}{rcl} \text{Cost Per Ton 18-46-0} & = & .18 \times 2,000 \times .08 = 28.80 \\ & & .46 \times 2,000 \times .08 = \underline{73.60} \\ & & 102.40 \end{array}$$

Price differences were determined by first adjusting for transportation costs and then subtracting the adjusted prices dealers charged for fertilizer from the standard price of \$102.40 per ton. These price differences were employed in testing the hypothesis that there is a significant difference in the prices charged for fertilizer in the different farming areas of North Dakota by the different type of fertilizer retail firms.

Analysis of Variance Results

The actual range of the price differences was found to be \$5.46 per ton after the fertilizer prices for the different analyses were standardized according to the base price for 18-46-0. Next, the standardized prices were tested in order to determine whether the different farming areas have a significant effect on fertilizer prices. The four farming areas were found to be charging prices which were significantly different statistically.

Transportation

The transportation cost to the fertilizer dealers in the various areas was computed in an attempt to explain some of the differences discovered in

the prices charged by retail dealers in different geographic areas of the state. The transportation cost data were analyzed to determine their statistical significance to prices charged for retail fertilizer. These costs were highly significant. Transportation costs were then subtracted from the standardized prices in order to further refine the data before further tests were conducted.

Complementary Business Activities

Selling fertilizer was the primary business for some firms; for others, it was secondary. It was hypothesized that the type of complementary business in which a firm was engaged may influence fertilizer prices. It may be possible to sell fertilizer for less markup if the retail dealers were engaged in the sale of other less seasonal complementary goods and services. The fertilizer firms were divided into three major categories due to the limited number of observations in some categories imposed by the raw data. The average price advantages which were found for dealers in each category are illustrated in Table 13.

TABLE 13. AVERAGE PRICE DIFFERENTIAL PER TON OF FERTILIZER SOLD BY THE TYPE OF COMPLEMENTARY BUSINESS IN NORTH DAKOTA, 1972

Complementary Business Category	Average Price Difference
Grain Elevator With Fertilizer Mixing	0.00
Farm Supply Stores With Fertilizer Mixing	+5.31
Retail Gasoline Stations With Fertilizer Mixing	+2.33

SOURCE: North Dakota Fertilizer Questionnaire, 1973.

Grain elevators included in the study charged a significantly lower price on the average than retail gasoline stations and farm supply stores (Table 13). Prices at retail gasoline stations and farm supply stores averaged \$2.33 and \$5.31 more per ton, respectively, than grain elevators for the fertilizer products they sold during the study period.

Total Tons of Fertilizer Sold

The variable considered next was the total tons of fertilizer sold by the retail dealers studied in the 1972 calendar year. Total tons of

fertilizer sold in 1972, when adjusted for regional price difference, was found to have a significant effect on the retail price charged. An interesting trend was noted in the average price advantages enjoyed by the different size dealers (Table 14). The average price charged per ton of fertilizer generally declined as tons sold increased up to the 4,001 to 5,000 ton per year level. Above the 5,000 ton per year sales level, prices per ton began increasing.

TABLE 14. AVERAGE PRICE ADVANTAGE PER TON OF FERTILIZER IN THE STUDY AREA BY SIZE OF FIRM'S TOTAL SALES IN NORTH DAKOTA IN 1972

Tons Sold in 1972	Number of Firms	Average Price Difference
0 - 1,000	31	+7.35
1,001 - 2,000	25	+3.22
2,001 - 3,000	13	+4.48
3,001 - 4,000	9	+4.26
4,001 - 5,000	6	0.00
5,001 or More	7	+3.13

SOURCE: North Dakota Fertilizer Questionnaire, 1973.

The smallest volume dealers were found to charge the highest price per ton. This factor can possibly be attributed to the low volume which might cause higher than normal handling costs. The relatively low volume of fertilizer handled could preclude the small firm from obtaining any of the normal discounts from its wholesaler that other larger, higher volume firms enjoy. The low volume firm was more likely to sell a higher percentage of bagged fertilizer which was also more expensive.

The firms which sold from 1,001 to 2,000 tons a year had approximately a \$1.15 per ton advantage over the two larger size groups.

There are several reasons for this price advantage. This smaller size dealership may not provide as many services as the larger firms and may not have invested in expensive services, such as rental application equipment, custom application equipment, or delivery equipment. The small firm may sell only certain analyses in bags and, therefore, eliminate the custom blending and handling equipment. Also, the small firm was likely involved in another business activity and, therefore, may not have fully allocated all costs to the fertilizer line.

The firms which sold from 2,001 to 5,000 tons per year provided the most services and likely have hired expert personnel. It was probable that the 4,001 to 5,000 tons per year size firm enjoyed certain economies of size which allowed it to offer the lowest price. It could be that at this size plant many of the services offered were covering costs or may have been profitable due to specialization in equipment and personnel.

The plants which sold over 5,000 tons appeared to be experiencing diseconomies of size or their higher price per ton may be evidence of market power being utilized in their pricing policies.

Percent of Total Income

Data in Table 15 indicate the results of an analysis of the impact of fertilizer specialization on pricing policy. The hypothesis tested was that the percentage of fertilizer sales accounted for in a firm's total sales would have a bearing on the price charged for that fertilizer. The results of this analysis indicate that there was a significant difference in retail prices of fertilizer among firms when related to levels of specialization. Results indicate that there was a direct relationship between retail prices and specialization rate.

TABLE 15. THE MEAN PRICE DIFFERENTIAL PER TON OF FIRMS WITH DIFFERENT PERCENTAGES OF TOTAL SALES DERIVED FROM FERTILIZER SALES IN NORTH DAKOTA, 1973

Fertilizer as a Percent of Total Sales	Average Price Difference
0 - 35	0.00
35 - 75	+2.69
75 - 100	+6.74

SOURCE: North Dakota Fertilizer Questionnaire, 1973.

Fertilizer is a seasonal input which enjoys its period of greatest demand in the spring of the year followed by a reduced demand during the summer and fall. There is almost no demand in this area in the winter. This may be the primary reason that the firms which obtain the greatest percentage of its total income from the sales of fertilizer must charge a

higher price. In order to remain in business the rest of the year, the fertilizer-oriented firm must charge a higher price than the diversified firm which has other product lines to use labor and fixed facilities during the low fertilizer sales periods.

Type of Ownership

The hypothesis that the type of ownership of a retail fertilizer dealership influenced the price charged by the retail firms was tested. Ownership was categorized into two major groups--the cooperatively owned and the privately owned. There were 53 cooperatives and 38 privately owned firms in the sample. Table 16 illustrates that the cooperatively owned firms in the sample sold fertilizer on a per ton basis at a lower price than did the average privately owned firms.

TABLE 16. AVERAGE PRICE DIFFERENTIAL PER TON BY THE TYPE OF FIRM OWNERSHIP FOUND IN NORTH DAKOTA, 1973

Type Ownership	Average Price Difference
Cooperative	0.00
Private	+6.11

SOURCE: North Dakota Fertilizer Questionnaire, 1973.

Appendix

COMMERCIAL FERTILIZER USED ON CROPLAND OF FARMS WITH SALES OF \$2,500 OR MORE, NORTH DAKOTA, POUNDS PER ACRE, 1954, 1959, 1964, 1969, AND 1974

County	1954	1959	1964	1969	1974
----- pounds per acre -----					
Adams	.14	5.53	7.95	13.08	12.53
Barnes	4.11	15.94	19.14	32.86	47.54
Benson	2.01	8.90	6.53	13.70	17.68
Billings	.35	3.14	6.83	7.55	7.52
Bottineau	2.05	6.09	7.40	12.04	22.50
Bowman	.92	5.75	8.78	13.88	13.22
Burke	.47	4.74	3.90	7.28	6.84
Burleigh	.19	7.05	3.82	9.79	12.93
Cass	8.34	22.32	30.96	58.59	95.89
Cavalier	7.11	14.53	15.88	25.96	37.21
Dickey	1.77	3.16	7.03	25.79	37.34
Divide	.53	1.31	1.24	3.71	5.90
Dunn	.54	5.54	6.82	12.36	10.12
Eddy	2.51	9.11	10.49	15.98	22.02
Emmons	.09	6.69	2.80	8.90	10.74
Foster	3.57	18.97	17.96	28.04	36.93
Golden Valley	1.99	6.72	8.66	15.34	22.05
Grand Forks	24.17	43.30	45.24	64.10	89.92
Grant	.79	4.00	5.05	9.92	6.87
Griggs	3.93	9.86	17.12	27.59	37.42
Hettinger	.48	9.39	11.20	15.37	15.72
Kidder	.22	2.15	1.43	4.62	5.25
LaMoure	.88	7.56	12.96	24.83	32.49
Logan	.07	3.23	2.35	8.58	9.07
McHenry	.72	9.21	6.46	12.24	13.09
McIntosh	.09	1.94	4.44	11.12	7.78
McKenzie	2.64	10.76	11.03	17.46	18.16
McLean	.38	7.16	6.32	11.80	11.98
Mercer	.26	6.34	5.43	10.80	13.71
Morton	.33	7.57	7.52	12.58	15.15
Mountrail	.19	3.92	3.19	7.03	8.35
Nelson	5.93	21.02	17.86	29.36	34.06
Oliver	.25	4.53	4.91	15.90	13.24
Pembina	28.24	41.57	40.63	72.22	119.76
Pierce	.85	6.25	4.31	9.09	10.51
Ramsey	1.81	9.68	8.69	16.52	18.70
Ransom	1.47	7.26	12.86	32.62	47.53
Renville	2.85	5.97	6.02	7.82	11.41
Richland	6.58	18.09	26.38	58.83	104.09
Rolette	2.57	5.33	6.37	11.91	23.62
Sargent	1.32	5.24	11.34	33.12	48.62
Sheridan	.25	2.92	3.58	7.49	9.02
Sioux	.20	1.17	2.51	7.81	6.70
Slope	.77	6.54	12.32	13.35	13.17
Stark	.58	8.03	10.79	13.93	13.19
Steele	8.16	20.43	22.75	38.17	67.95
Stutsman	.86	9.30	13.87	23.77	31.69
Towner	3.03	9.31	8.95	18.04	28.49
Traill	10.95	21.63	30.14	54.92	93.70
Walsh	23.27	39.72	54.99	74.14	105.44
Ward	1.24	8.32	7.77	11.99	15.36
Wells	1.74	9.87	11.26	20.33	25.56
Williams	1.10	4.95	4.84	8.06	8.52

SOURCE: U.S. Department of Commerce, Bureau of the Census, Census of Agriculture.

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